1981

A Summary of Research Projects Sponsored by the Office of Naval Research. Report for the Period 1 October 1980 to 30 September 1981

Monterey, California. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

Monterey, California

A SUMMARY OF RESEARCH PROJECTS SPONSORED BY
THE OFFICE OF NAVAL RESEARCH

Report for the Period

1 October 1980 to 30 September 1981

Title: Operating System Structures for Distributed Multi-Microcomputer Systems

Investigators: Uno R. Kodres, Associate Professor of Computer Science; Roger R. Schell, Associate Professor of Computer Science

Sponsor: Office of Naval Research

Objective: Identify hardware and operating system software characteristics for effective use of multi-microcomputers in combat systems.

Summary: The recent development of Very Large Scale Integrated (VLSI) general purpose computers will radically change the economics and design concepts of dedicated computational systems which can be built from concurrently operating multi-computer systems composed of commercially successful single board (in the future, single chip) computers. The purposes of this study: (1) identify operating system's structures that will more effectively support combat systems applications, (2) provide architectural guidelines for hardware design and support the required operating system capabilities and efficiencies and (3) to identify the hardware and operating system features which enhance the implementation of secure systems composed of multi-microcomputers.

The development of a family of multi-microcomputer executive systems has continued from designs which were completed a year ago to implementation. Recovery from a system malfunction caused by a processing element was designed and partially implemented. System initialization which dynamically determines the available resources was designed and implemented. The kernel of a real time multiprocessor operating system was tested on a single processor and dual processor systems. The CPM-86 operating system was adapted to the hardware environment which exists in our multi-microcomputer laboratories.

Theses Directed: Demonsthenis K. Rapantzikos, "Detailed Design and Implementation of the Kernel of a Real-Time Distributed Microprocessor Computer System. Master's Thesis, March 1981.

Richard L. Anderson, "Automatic Recovery in a Real-Time Distributed Multiple Microprocessor Computer System. Master's Thesis, Dec. 1980.

Lawrence J. Shirley, "Non-Discretionary Security Validation by Assignment. Master's Thesis, June '81.

Gary S. Baker, "Initialization Design for Dynamic Determination of Resources. Master's Thesis, June '81.

Michael B. Candalor, "Alteration of the CP/M-86 Operating System. Master's Thesis, June '81.

Title: Large-Scale Optimization

Investigators: Gerald G. Brown, Professor of Operations Research, and Gordon H. Bradley, Professor of Computer Science

Sponsor: Office of Naval Research

Objective: Develop theory and algorithms for solution of large-scale optimization models.

Summary: The NPS research program in large-scale optimization has continued with significant progress in several areas. Network optimization has been extended to include new algorithms for elastic and mixed-integer models with fixed charges. A micro-computer based system has been completed with linear, nonlinear, and mixed integer algorithms, large-computer interfaces, and user friendly editors and operating system. Large-scale nonlinear and nonlinear mixed integer models have been solved in a new benchmark series evaluating the experimental optimization system XS. Interactive model-building systems have been developed and applied. The NPS research program has apparently assembled one of the most powerful optimization laboratories extant.

Publications:

G. Brown and W. Wright, "Automatic Identification of Embedded Special Structure in Large-Scale Optimization," in Computer Assisted Model Analysis and Simplification, H. Greenberg and J. Maybee, eds., Academic Press, 1980, pp. 61-90.

G. Brown and D. Thomen, "Automatic Identification of Generalized Upper Bounds in Large-Scale Optimization Models," Management Science, V. 26, No. 11, November 1980, pp. 1166-1184.

G. Brown and W. Wright, "Automatic Identification of Network Rows in Large-Scale Optimization Models," Technical Report NPS55-80-030, November 1980, 27 pp. (Also forthcoming in the open literature.)

G. Bradley, G. Brown and G. Graves, "Structural Redundancy in Large-Scale Optimization Models," Technical Report NPS55-80-029, November 1980, 44 pp. (Also forthcoming in the text: Redundancy in Mathematical Programming, edited by S. Zionts and S. Telgen, Academic Press.)

G. Brown and G. Graves, "Real-Time Dispatch of Petroleum Tank Trucks," Management Science, V. 27, No. 1, January 1981, pp. 19-32.

G. Brown, A. Geoffrion and G. Bradley, "Production and Sales Planning with Limited Shared Tooling at the Key Operation," Management Science, V. 27, No. 3, March 1981, pp. 247-259.

G. Brown and D. Thomen, "Automatic Identification of Generalized Upper Bounds in Large-Scale Optimization Models," appears in Large-Scale Linear Programming, G. Dantzig, M. Dempster and M. Kallio, eds., International Institute for Applied Systems Analysis, Laxenburg, Austria, 1981, pp. 747-780.

G. Brown and W. Wright, "Automatic Identification of Embedded Structure in Large-Scale Optimization Models," appears in Large-Scale Linear Programming, G. Dantzig, M. Dempster and M. Kallio, eds., International Institute for Applied Systems Analysis, Laxenburg, Austria, 1981, pp. 781-808.

G. Brown and R. McBride, "Efficient Solution of Generalized Network Problems," Technical Report, School of Business, University of Southern California, September 1981, 34 pages. (Also forthcoming in the open literature.)

G. Brown and R. McBride, "Extracting Embedded Generalized Network Problems from General LP Problems," Technical Report, School of Business, University of Southern California, September 1981, 11 pages. (Also forthcoming in the open literature.)

G. Brown, G. Graves and M. Honczarenko, "Large-Scale Facility and Equipment Location: An Application of Goal Programming in Multicommodity Decomposition," Technical Report, University of California, Los Angeles, September 1981, 24 pages. (Also forthcoming in the open literature.)

G. Brown, G. Bradley and G. Graves, "Review of Computational Aspects of the CRA/EPRI Coal Market Analysis System," Electric Power Research Institute Technical Report, May 1981.

G. Brown, G. Bradley and G. Graves, "Review of the Computational Aspects of the TBS Regulatory Analysis Financial Model," Electric Power Research Institute Technical Report, September 1981.

Conference Presentations:

G. Brown and D. Dean, "Experiments Using a Large-Scale Optimization System with Nonlinear and Integer Models," CORS/ORSA/TIMS International Conference, Toronto, 1-3 April 1981.

G. Brown and R. Duff, "Network Optimization with a Microcomputer: A Live Demonstration and Tutorial," CORS/ORSA/TIMS International Conference, Toronto, 1-3 April 1981.

G. Brown and D. Thomen, "Automatic Identification of Generalized Upper Bounds in Large-Scale Optimization Models," CORS/ORSA/TIMS International Conference, Toronto, 1-3 April 1981.

G. Brown, G. Graves and D. Dean, "Computational Experiments with Large-Scale Nonlinear Optimization," CORS/ORSA/TIMS International Conference, Toronto, 1-3 April 1981.

G. Brown, G. Graves and M. Honczarenko, "Large-Scale Facility and Equipment Location: An Application of Goal Programming in Multicommodity Decomposition," ORSA/TIMS, Houston, 18-21 October 1981.

Theses Directed:

D. Dean, "Computational Advances in Large-Scale Nonlinear Optimization," Master's Thesis, September 1981.

C. Burchinal, "IVONNE: An Interactive Network Model-Building System," Master's Thesis, September 1981.

R. Duff, "A Microcomputer-Based Network Optimization Package," Master's Thesis, September 1981.

Title:	Stochastic Modeling and Data Analysis
Investigator:	Donald P. Gaver, Professor of Operations Research and Statistics
Sponsor:	Office of Naval Research
Objective:	To develop, and show how to apply, statistical methods of data analysis and probability modeling to problems arising in the environment, to communications problems, computer systems including military C^3, and equipment reliability.
Summary:	Studies were conducted, and models constructed, for communications systems that cooperatively service voice and data. A probability-theoretical analysis was conducted of the time to failure for a mechanical system suffering superpositions of random loads. Statistical analysis and modeling of ice thickness data was initiated in cooperation with P. A. Jacobs (OR, NPS) and Dr. D. Wadhams of Scott Polar Research, Cambridge, England.
Publications:	D. P. Gaver, P. A. Jacobs, "On Combinations of Random Loads," SIAM Journal of Applied Mathematics, 40 (1981), pp. 459-466.
	D. P. Gaver, P. A. W. Lewis, "First-Order Auto-Regressive Gamma Sequences and Point Provesses," Advanced Applied Probability 12 (1980), pp. 722-745.
	D. P. Gaver, P. A. Jacobs. "Storage Problems When Demand is 'All or Nothing'," Naval Research Logistics Quarterly 27 (1980), pp. 529-538.
	J. Lehoczky, D. P. Gaver, "Diffusion Approximations for the Cooperative Service of Voice and Data Messages," Journal of Applied Probability 18 (1981), pp. 660-671.
	D. P. Gaver, J. P. Lehoczky, "Channels that Cooperatively Service a Data Stream and Voice Messages," IEEE Trans. Communication Society (1981).
Conference Presentation:	D. P. Gaver and J. P. Lehoczky, "Performance Evaluation of Voice-Data Queueing Networks," Probability and Computer Science - The Interface, Boca Raton, Florida, January 1981.

Theses Directed:

B. Aba, "Investigation of Alternative Methods, Including Jackknifing, for Estimating Point Availability of a System," September 1981.

C. Janusch, "Statistical Analysis of Three High-Frequency Direction Finding Algorithms with Bearing Selection Based on Ionospheric Models," Master's Thesis, September 1981 (2nd reader).

Title: Collection System Performance Optimization Study

Investigators: Jeffrey B. Knorr, Associate Professor of Electrical Engineering
Donald D. Barr, Professor of Operations Research and Statistics

Sponsor: Office of Naval Research

Objective: To develop a systematic method for optimizing the performance of a collection system against specified target emitters. Supporting work on emitter antenna modeling and intercept probabilities is included.

Summary: When several sensors are concurrently scanning the same domain for signals, varying numbers of sensors may detect each signal. On some occasions, a signal may not be detected by any of the receivers. Using detection data collected from all the receivers over a period of scanning, it is possible to estimate the total number of signals that occurred in that period (including those that were not detected at all), as well as the detection probabilities for the individual receivers. Several estimators for these quantities were developed, in the contexts of several models concerning the signal generation process and the receiver behavior.

Publications: D. R. Barr, "Estimation of Sensor Detection Probabilities with Data from Concurrent Sensors," Technical Report NPS55-81-014, August 1981.

Thesis Directed: D. S. Hendrickx, "An Evaluation of Estimators for Receiver Detection Probabilities and Unknown Signal Population Size," Master's Thesis, September 1981.

M. Scagnelli, "Computer Modeling of Reflector Antenna Far Field Sidelobe Levels," Master's Thesis, December 1981.

Title: Stochastic Analysis and Simulation

Investigator: Peter A. W. Lewis, Professor of Statistics and Operations Research

Sponsor: Office of Naval Research

Objective: To develop simple, tractable models for the analysis of stochastic point processes and time series; to develop new statistical methodology for use in the simulations which are required in mathematical statistics and in the analysis of systems; to pursue data analysis and stochastic modelling for stochastic systems such as the Circadian sleep-wake process in mammals.

Summary: This ongoing project has two aspects, the development of statistical methods and stochastic models for time series, and the development of new simulation methodology.

A previously developed exponential time series model (EAR(1)) was extended to broader, two parameter structure called NEAR(1) (new exponential autoregressive process of order 1). This model in turn was extended to a process with mixed exponential marginal distributions which can be given a complete autoregressive-moving average structure. Problems with statistical estimation for these models led to formulation of a Gamma process which should have broad applicability. An investigation into the use of this model for modelling wind velocity data was initiated.

In simulation a long-standing problem of estimating quantiles in the dependent sequences which arise in systems simulations has been definitively solved. Both point and confidence interval estimates were obtained. Also a graphical and statistical methodology called regression adjusted graphics and estimation was applied to regenerative systems simulations. The result is a sequential procedure which fully exploits the regenerative structure and produces a stopping rule and a direct variance estimate for the regenerative point estimate. This technique is also being applied to other, non-regenerative simulations.

Publications:

P. A. W. Lewis, "Chapter G of the IMSL Library-Generation and Testing of Random Variables," Proceedings 1980 Winter Simulation Conference, 1980, IEEE, New York, 353-360.

P. A. W. Lewis and A. J. Lawrance, "The Exponential Autoregressive-Moving Average EARMA(p,q) Process," Journal Royal Statistical Society 43, 2, 1980, 150-161.

P. A. W. Lewis and P. Heidelberger, "Regression Adjusted Estimates for Regenerative Simulations with Graphics," Communications of the ACM 24, 4, 1981, 260-273.

P. A. W. Lewis and A. J. Lawrance, "A New Autoregressive Time Series Model in Exponential Variables (NEAR(1))," Journal of Applied Probability, 1981, to appear.

P. A. W. Lewis and A. J. Lawrance, "A Mixed Exponential Time Series Model, NMEAR(p,q)," Naval Postgraduate School Technical Report, NPS55-80-012, March 1980; to appear in Management Science.

P. A. W. Lewis and A. J. Lawrance, "Generation of Some First-Order Autoregressive Markovian Sequences of Positive Random Variables with Given Marginal Distributions," NPS Technical Report, NPS55-81-003, March 1981; to appear in Proceedings Applied Probability/Computer Science, R. Disney, ed.

P. A. W. Lewis and L. Uribe, "The New Naval Postgraduate School Random Number Package LLRANDOM II," NPS Technical Report, NPS55-81-005, February 1981.

P. A. W. Lewis and P. Heidelberger, "Quantile Estimation for Dependent Sequences" NPS Technical Report, NPS55-81-015, September 1981; submitted to Operations Research.

P. A. W. Lewis, G. Richardson and W. Dement, "Serial Correlation in Sleep and Wakefulness States in the Mouse: Dependence on Circadian Phase," NPS Technical Report, NPS55-81-022, September 1981.

Conference Presentations:

P. A. W. Lewis, "Discrete Time Series Generated by Mixtures," Joint Civil Engineering-Statistics Seminar, Purdue University, 1 October 1980.

P. A. W. Lewis, "Graphical and Statistical Methodology for Analysis of Circadian Rhythms in EEG States," Stanford Biostatistics Seminar, Stanford, CA, 30 October, 1980 (with G. Richardson).

P. A. W. Lewis, "Some Models for Time Series of Positive, Continuous Variables," U.S. Army Corps of Engineers, Water Experimental Station, Vicksburg, Mississippi, 12 November 1980.

P. A. W. Lewis, "Serial Correlation in Sleep and Wakefulness States in the Mouse: Dependence on Circadian Phase," Stanford Psychiatry Department Sleep Research Seminar, 11 December 1980.

P. A. W. Lewis, "Some Schemes for Autoregression of Continuous Random Variables," University of North Carolina, Joint Statistics and Operations Research Seminar, 1 December 1980.

P. A. W. Lewis, "Chapter G. of the IMSL Library-Generation and Testing of Random Variables," Winter Simulation Conference, Orlando, Florida, 3-5 December 1980.

P. A. W. Lewis, "Some Schemes for Autoregression of Continuous Random Variables," University of Georgia, Statistics and Computer Science Seminar, 6 December 1980.

P. A. W. Lewis, "Generation of Random Variables by Poisson Thinning," Applied Probability/Computer Science Symposium, Boca Ratan, Florida, 3 January 1981.

P. A. W. Lewis, "Generation of Random Variables by Thinning Poisson Processes," 1981 Computer Science/ Statistics Interface Symposium, Pittsburgh, PA, 12-13 March 1981.

P. A. W. Lewis, "Regression Adjusted Regenerative Simulation, with Graphics," Naval Postgraduate School Seminar (with P. Heidelberger), 18 March 1981.

P. A. W. Lewis, "Regression Adjusted Regenerative Simulation, with Graphics," Imperial College, University of London Statistics Seminar, 1 April 1981.

P. A. W. Lewis, "Regression Adjusted Regenerative Simulation, with Graphics," University of Birmingham Statistics Department Seminar, 2 April 1981.

P. A. W. Lewis, "Regression Adjusted Regenerative Simulation, with Graphics," Bell Telephone Laboratories, Murray Hill, NJ, 19 May 1981.

P. A. W. Lewis, "Quantile Estimation for Dependent Sequences," University of California, San Diego, Statistics Seminar, 1 June 1981.

P. A. W. Lewis, "Simple Time Series with Exponential, Gamma and Hyperexponential Marginal Distributions," IBM Research Labs, Yorktown Heights, 22 July 1981.

P. A. W. Lewis, "Simple Time Series with Exponential, Gamma and Hyperexponential Marginal Distributions," IBM Systems Research Center, NY, August 1981.

Title:	Africa in the 1980s: Continuity and Change
Investigators:	Michael Clough, Adjunct Professor, Department of National Security Affairs, and Helen Kitchen, Director of African Studies, CSIS, Georgetown University
Sponsor:	Office of Naval Research
Objective:	To identify likely patterns of change in Africa that could impact on American interests on the continent in the 1980s.
Summary:	A major conference will be held in May 1982 at the Naval Postgraduate School. Papers will be presented by regional experts on North Africa, West Africa, the Horn of Africa and Southern Africa. Based on the findings of this conference the principal investigators will attempt to project future political, economic and military trends in the region and provide a set of guidelines for future U.S. policy.

Title: Exploratory Experiments of the Stimulated Cerenkov Radiation Using 30-100 MeV Electrons

Investigator: Fred R. Buskirk, Professor of Physics

Sponsor: Office of Naval Research

Objective: Preliminary measurements of stimulated cerenkov effect using high energy electrons.

Summary: The stimulated Cerenkov process may provide an alternative to the free electron laser in producing radiation from the mm microwave range through the infrared optical region. Previous work has employed electron of about 0.3 MeV energy interacting with a dielective slab resonator to produce microwaves. The present experiments start to explore the possibility of using higher energy electron which would be necessary to future extension of the methods to the optical range. An unexpected result from these early measurements in the effectiveness of the techniques for monitoring the temporal structure of electron accelerator beams in the 10^{-9} sec region.

Theses Directed: D. E. McLaughlin, "Cerenkov Radiation Produced by 100 MeV Electrons," Master's Thesis, June 1981.

L. E. Brown, "Stimulated Cerenkov Radiation Experiments," Master's Thesis, December 1981.

Title:	Geomagnetic Fluctuations on the Ocean Floor
Investigator:	O. Heinz, Professor of Physics
Sponsor:	Office of Naval Research
Objective:	The objective of this research is the study of the spatial and spectral properties of naturally occurring electromagnetic fields on and near the ocean floor. The purpose of these studies is to obtain improved long term data, to estimate sea-floor conductivities and to identify the separate origins of the contributing signal sources.
Summary:	During FY 81 we continued and extended our measurements of geomagnetic field fluctuations on the floor of Monterey Bay and also initiated data transmission from Chew's Ridge Monitoring Station. A comparison of our land and sea data shows that in addition to a large swell induced signature at about .07 Hz the power spectrum of the sea signals is consistently higher by 10 to 15 db over the entire frequency range (.01 to 1 Hz). Simultaneous measurements of the vertical and horizontal component of the sea floor signal were carried out over the frequency range 0.01 Hz to 20 Hz.
Thesis Directed:	Gary M. McKinley and Robert M. Santos, "Characteristics of Geomagnetic Power Spectra on Land and Sea in the Period Range .2 to 400 sec.", Master's Thesis, December 1980.

Title: Transmission of Acoustic Energy from a Fluid Wedge into a Fast Bottom

Investigators: James V. Sanders and Alan B. Coppens, Associate Professors of Physics

Sponsor: Office of Naval Research

Objective: To develop the ability to predict the properties of a sonic beam transmitted into a fast bottom underlying a wedge-shaped fluid-like layer.

Summary: This is a continuation of an ongoing project. Since the summary presented in last year's activity report, a commercial sand (#30 fine) has been shown to have the values of density, speed of sound, and attenuation suitable for modeling the problem in a laboratory size facility. With proper degassing procedures, the reflection and transmission coefficients of the sand at normal incidence have been shown to be in agreement with those predicted from the measured values of density and sound speed. This demonstrates that microbubble retention need not be a serious problem and that measurements made with buried receivers will be reliable. An experimental facility has been designed to make measurements over and within a sloping sand bottom. The tank will be 10 ft long, 4 ft wide, and 3 ft deep, and will allow bottoms with slopes greater than 6° to be studied at 100 kHz. The source can be positioned 20 dump distances or more from the shore, and the beam in the bottom can be measured at distances at least 10 dump distances inland from the shore. The latest computer program for the WANG, WEDGE 13, the thirteenth generation program based on the simple physical model (incorporating stationary phase and steepest descent approximations) is virtually complete. One revision is required to approximate the pressure just beneath the boundary, and then complete agreement is expected between

the WEDGE program and the older and more time consuming ASMT program. Losses in the bottom have been incorporated and the subroutine incorporating the effect of bottom losses on the reflection coefficient has been designed and implemented.

Publications: A. B. Coppens, J. V. Sanders, G. I. Ioannou, and M. Kawamura, "Two Computer Programs for the Evaluation of the Acoustic Pressure Amplitude and Phase at the Bottom of a Wedge-Shaped, Fluid Layer Overlying a Fast, Fluid Half Space", NPS Technical Report, NPS-61-79-002, 1980.

Theses Directed: J. Bradshaw, "Laboratory Study of Sound Propagation into a Fast Bottom Medium", Master's Thesis, June 1981

Title:	Geomagnetic Fluctuations on the Ocean Floor
Investigators:	Paul Moose, Associate Professor of Electrical Engineering
Sponsor:	Office of Naval Research
Objective:	The objective of this research is the study of the spatial and spectral properties of naturally occuring electromagnetic fields on and near the ocean floor. The purpose of these studies is to obtain improved long term data, to estimate sea-floor conductivities and to identify the separate origins of the contributing signal sources.
Summary:	During FY 81 we continued and extended our measurements of geomagnetic field fluctuations on the floor of Monterey Bay and also initiated data transmission from Chew's Ridge Monitoring Station. A comparison of our land and sea data shows that in addition to a large swell induced signature at about .07 Hz the power spectrum of the sea signals is consistently higher by 10-15 dB over the entire frequency range (.01 to 1 Hz). Simultaneous measurements of the vertical and horizontal component of the sea floor signal were carried out over the frequency range 0.01 Hz to 20 Hz.
Thesis Directed:	Gary M. McKinley & Robert M. Santos, "Characteristics of Geomagnetic Power Spectra on Land and Sea in the Period Range .2 to 400 sec.," Master's Thesis, Dec 80.

Title:	Measurement of Natural Resonance Parameters for Radar Target Identification
Investigators:	Michael Morgan, Assistant Professor of Electrical Engineering
Sponsor:	Office of Naval Research
Objective:	To investigate various signal processing techniques for extraction of natural resonance data in the presence of noise and clutter.
Summary:	This new project, being initiated in Jul 81, is a follow-on to that sponsored by the NPS Research Foundation. Experimental measurements of complex natural resonances are being performed for a variety of radar targets of military interest. Investigations of optimum classification schemes using noisy data are being conducted. A parallel theoretical effort directed at relating natural resonances to target geometry is being pursued.
Thesis Directed:	D. Papaspiradakos, "Signal Processing Techniques for Radar Target Identification", Master's Thesis, Sep 81.

Title:	Reduced Order Characterization of Circuits and Systems
Investigator:	S. R. Parker, Professor of Electrical Engineering
Sponsor:	Office of Naval Research
Objective:	To investigate techniques for the macroscopic modeling of linear and nonlinear circuits and systems for purposes of performance analysis and fault detection.
Summary:	Our research has extended the single channel lattice autoregressive model to the multichannel case so as to be able to model both linear and nonlinear autoregressive moving average (ARMA) systems. Batch (block) processing and on-line (sequential) adaptive algorithms have been developed and tested to successfully model zero/pole linear systems as well as nonlinear ARMA systems including band pass nonlinearities and phase locked loops.
Publications:	S. R. Parker & F. A. Perry, "A Discrete ARMA Model for Nonlinear System Identification", IEEE Transactions on Circuits & Systems, Vol. CAS-28, No. 3, pp 224-233, Mar 81. S. R. Parker, "Macroscopic Modeling of Linear & Nonlinear Circuits & Systems", NPS-62Px-81-034, Sep 81.
Conference Presentations:	F. A. Perry, S. R. Parker, & M. Romeo, "The Use of Lattice Modelling for Large Scale Linear & Nonlinear Filters", Proc. of IEEE International Conference on Circuits & Computers, pp 800-803, Oct 80. S. R. Parker & F. A. Perry, "Transitional Formulas for Zero Pole Modeling", Proc. of International Conference on Digital Signal Processing, pp 734-741, Sep 81. S. R. Parker, "Discrete Signal Processing Applied to the Macroscopic Modeling of Linear and Nonlinear Circuits & Systems", Proc. of the 1981 European Conf. on Circuit Theory & Design, Delft University Press, North Holland Publishing Co., pp 127-131, Aug 81.

S. R. Parker, "The Mathematics of Multichannel Recursive in Order Lattice Parameter Modeling", 1981 Proc. of International Symposium on the Mathematical Theory of Networks & Systems (MTNS)", p 227, Aug 81.

Thesis Directed:

M. Romeo, "Multichannel ARMA Lattice Modeling with Application to the Phase Locked Loop", Elec Engr Thesis, Dec 80.

L. Mayoral, "Adaptive ARMA Modeling Based upon a Kalman Filter Formulation", Elec Engr Thesis, Jun 81.

I. Tumenbatur, "The Calculation of High Order Correlations & Nonlinear System Identification", Master's Thesis, Dec 80.

Title:	Eleventh International Symposium on Acoustical Imaging
Investigator:	John P. Powers, Associate Professor of Electrical Engineering
Sponsor:	Office of Naval Research
Objective:	Seed funds to hold the subject symposium at the Naval Postgraduate School, Monterey, CA, 4-7 May 81
Summary:	The 11th Symposium on Acoustical Imaging was held as indicated. Eighty-eight researchers from industry, government and academia heard forty-three papers presented on various aspects of acoustical imaging including medical applications, underwater viewing, nondestructive testing and acoustic tomograpy.
Publications:	J. P. Powers, Editor, Acoustical Imaging, Vol. 11. to be published by Plenum Publishing, New York.

Title: Relating Marine Aerosol Distribution to Oceanic Whitecaps

Investigator: K. L. Davidson, Associate Professor, Department of Meteorology, and G. E. Schacher, Professor of Physics, Department of Physics and Chemistry

Sponsor: Office of Naval Research

Objective: To determine aerosol production per unit whitecap coverage on the basis of laboratory measurements and to relate open ocean aerosol data and whitecap coverage.

Summary: Measurements of seasalt aerosols were made in June 1980 over laboratory generated whitecaps at University College Galway. Preliminary estimates were obtained of the produced aerosol size distributions as a function whitecap coverage (Monahan et al, 1982), based on data obtained in 1979. Aerosol size distributions obtained during the JASIN (North Atlantic) experiment in 1978 have been interpreted relative to aerosol flux spectra (Fairall et al, 1982).

Publications: E. C. Monahan, K. L. Davidson and D. E. Spiel, "Whitecap Aerosol Productivity Deduced from Simulation Tank Measurements", Journal of Geophysical Research, forthcoming.

C. W. Fairall, K. L. Davidson and G. E. Schacher, "An Analysis of the Surface Production of Sea-Salt Aerosols", Tellus, forthcoming.

Title: Numerical Modeling of Large-Scale Ocean Variability

Investigator: Robert L. Haney, Associate Professor of Meteorology

Sponsor: Office of Naval Research

Objective: To continually develop and improve a numerical model of the North Pacific Ocean and to use the model to identify processes responsible for the formation and evolution of large-scale thermal anomalies in the ocean.

Summary: Two studies of synoptic storm activity over the North Pacific Ocean and its relation to large scale sea surface temperature anomalies have been made using a special data set of 6-hourly surface wind analyses prepared by FNOC. These wind data have been used to drive a new embedded mixed layer ocean circulation model in a 10-year hindcast (1969-1978) of the currents and temperature structure in the Central Midlatitude North Pacific Ocean.

Publications:

R. L. Haney, M. S. Risch and G. C. Heise, "Wind Forcing Due to Synoptic Storm Activity over the North Pacific Ocean", Atmosphere-Ocean, 19(2), (forthcoming).

D. Adamec, R. L. Elsberry, R. W. Garwood, Jr. and R. L. Haney, "An Embedded Mixed Layer-Ocean Circulation Model", Dyn. Atmos. Oceans, 5, (forthcoming).

R. L. Haney, "Preliminary Results from an Embedded Mixed Layer-Ocean Circulation Model", Proceedings Workshop on Ocean Prediction, (forthcoming).

Conference Presentations:

R. L. Haney, "Model Simulated Relationship between Surface Winds and Surface Currents in the North Pacific", Fall Annual Meeting of the AGU, San Francisco, CA, Dec 8-10, 1980.

R. L. Haney and W. H. Little, "A Statistical Study of Monthly Anomalies of Synoptic Storm Activity and Sea Surface Temperature over the North Pacific", AMS First Conference on Climate Variations, San Diego, CA, Jan 19-23, 1981.

R. L. Haney, "Preliminary Results from an Embedded Mixed Layer-Ocean Circulation Model", Proceedings Workshop on Ocean Prediction, Naval Postgraduate School, Monterey, CA, 29 Apr-2 May 1981.

Title: Axial Compressor Flow Fields

Investigator: Dr. Raymond P. Shreeve, Director, Turbopropulsion Laboratory, Department of Aeronautics

Sponsor: Office of Naval Research

Objective: To obtain an improved understanding of the flow fields in axial compressors required to formulate new analytical prediction models and to obtain detailed measurements against which new computer analysis codes can be verified.

Summary: The complete definition of the flow field leaving a high speed single stage axial rotor in a rotor-first arrangement is the primary goal. A new measurement technique termed "Dual-Probe Digital Sampling," or DPDS, involving two semi-conductor probes of simple geometry, was developed for this purpose. The measurements to be obtained using DPDS will be compared with LDV measurements of the same flow. To date first measurements of all three components of the rotor exit velocity as a map across two selected rotor blade passage have been obtained. Tests to obtain similar data at transonic relative Mach numbers, both on- and off-design, are planned. The calibration of a second-generation probe system was recently completed. The DPDS technique is thought to have a significant potential as a diagnostic technique for turbomachines.

A number of publications have been generated since the projects inception; only those for FY 81 are listed.

Publications:

D. Adler, and P. M. Taylor, "A Procedure for Obtaining Velocity Vector from Two High Response Impact Pressure Probes," NPS Technical Report, NPS67-80-007, August 1980.

R. P. Shreeve and F. Neuhoff, "Compressor Measurements Using a Dual-Probe Digital Sampling (DPDS) Technique," submitted for presentation at the AIAA/ASME/SAE 18th Joint Propulsion Conference to be held in Cleveland, Ohio, June 21-23, 1982.

Conference Presentation:

R. P. Shreeve, "A Simple Fixed-Probe Technique for Periodically Unsteady Flows," Aeroelasticity of Turbine Engines; Joint NASA/AF/Navy Symposium, Cleveland, Ohio, October 27-29, 1980.

Title: Studies of the Oceanic Planetary Boundary Layer

Investigator: Roland W. Garwood, Jr., Assistant Professor, Department of Oceanography

Sponsor: Office of Naval Research

Objective: To understand by means of model studies and data analyses the role of the oceanic planetary boundary layer in the distribution of momentum, energy and mass in the upper ocean.

Summary: The present understanding and predictive capabilities of one-dimensional mixed layer models has matured to the point that many practical applications of these models are now being attempted. From knowledge of the limitations of the one-dimensional approximation, the impetus has been to include horizontal advection to study two and three-dimensional upper ocean problems. A milestone for this project was the successful embedding of a bulk turbulence closure mixed layer model in a multi-level primitive equation model for ocean circulation. This embedded model is now being used for a study of the response of upper ocean density fronts to local atmospheric forcing, and the interaction between the ocean mixed layer and planetary waves and eddies.

Publications:

D. D. Adamec, R. L. Elsberry, R. W. Garwood, Jr., and R. L. Haney, "An Embedded Mixed Layer Ocean Circulation Model," Dynamics of Atmospheres and Oceans, 6: 69-96, (forthcoming).

L. K. Coachman and R. W. Garwood, Jr., "Response of the Upper Ocean to Calm Wind--Observations of the Bering Sea Shelf," PROBES, Processes and Resources of the Bering Sea Shelf, V. II, 1-48, (forthcoming).

R. L. Elsberry and R. W. Garwood, Jr., "Numerical Ocean Prediction Models--Goal for the 1980's," Bulletin of the American Meteorological Society, 61: 1556-1566, 1980.

R. W. Garwood, Jr., R. Lasker, and L. K. Coachman, "One-Dimensional Model Simulation of the Central Shelf Domain of Bristol Bay for the Period 8-10 June 1979," PROBES, Processes and Resources of the Bering Sea Shelf, V. II, 261-174, 1980.

R. W. Garwood, Jr., R. W. Fett, K. M. Rage, and H. W. Brandli, "Ocean Frontal Formation Due to Shallow Water Cooling Effects as Observed by Satellite and Simulated by a Numerical Model," Journal of Geophysical Research, (forthcoming).

Conference Presentations:

R. W. Garwood, Jr., R. Shook, and R. L. Elsberry, "One-Dimensionality of the Ocean Boundary Layer During the Norpax Pole Experiment," Transactions American Geophysical Union, 62: 990, 1980.

R. W. Garwood, Jr., "Use of a Desk-Top Computer for Local Upper Ocean Thermal Structure Forecasts," Ocean Prediction Workshop 81, Monterey, 1981.

Theses Directed:

J. M. Fernandez, "Analysis and Simulation of Wind-Driven Currents During the Mixed Layer Experiment," Master's Thesis, March 1981.

R. Fisher, "Variability and Sensitivity of Coupled Mixed Layer Acoustic Model System," Master's Thesis, March 1981.

Title: Biology of Stone and Wood Boring Animals in the Monterey Submarine Canyon and the Deeper Waters off the Central California Coast

Investigator: Eugene C. Haderlie, Professor, Department of Oceanography

Sponsor: Office of Naval Research and NORDA

Objectives: To determine the vertical and horizontal distribution of stone and wood boring marine animals of the deeper waters of Monterey Bay and offshore, and to determine the rates of destruction of wood, stone, concrete and various plastics.

Summary: During the past year new arrays have been planted in deeper water and have been successfully recovered for laboratory analysis for borers. The larval stages of some of these were collected and studied for the first time. Samples of stone with known infestations of stone borers were brought to the laboratory at regular intervals and x-rayed to determine rates of growth and stone destruction.

Publications: E. C. Haderlie, "Influence on Terminal End of Burrow on Callum Shape in the Rock Boring Clam Penitella penita (Conrad, 1837)," The Veliger 24: 51-53, 1981.

E. C. Haderlie, "Growth Rates of Penitella penita (Conrad, 1837), Chaceia ovoidea (Gould, 1851) (Bivalvia: Pholadidae) and Other Rock Boring Marine Bivalves in Monterey Bay," The Veliger 24: 109-114, 1981.

Conference Presentations: E. C. Haderlie: "Effects of Macrofouling and Biodeterioration on Engineering Materials in the Sea," Symposium on Marine Biodeterioration, Washington, D.C., April 1981.

E. C. Haderlie: "Monitoring Growth Rates of Wood and Stone Boring Marine Bivalves Using Radiographic Techniques," 5th International Biodeterioration Symposium, Aberdeen, Scotland, September 1981.

Thesis Directed: R. G. Hoffman, "The Ecology of Benthic and Endolithic Communities of a Rocky Reef in the Kelp Beds off Del Monte Beach, Monterey, California," Master's Thesis, June 1981.

Title: Synoptic Studies of Oceanic Fronts and Upper Ocean Prediction

Investigator: C. N. K. Moores, Professor and Chairman, Department of Oceanography

Sponsor: Office of Naval Research

Objective: The long-range scientific objective is to develop a predictive capability for the mass and circulation fields in the upper ocean. The phenomena to be addressed are upper ocean fronts and eddies. The first step is to produce synoptic analyses, with the aid of observations and diagnostic models, of the present physical state in and around upper ocean fronts and eddies. The second step is to develop prognostic models, and validation schemes, for short range forecasts.

Summary: The present project involves the analysis of large scale fields in the time and space domain of the FRONTS experiment conducted in the winter of 1979/1980 on the North Pacific Subtropical Front. The surface atmospheric fields and surface and subsurface temperature fields available in the Fleet Numerical Oceanography Center archives form the core of the analyses. The Naval Environmental Prediction Research Facility's satellite data processing facility (SPADS) is being used to process several GOES WEST IR images to be incorporated in the analyses. These products will be used in a cooperative synthesis of the FRONTS experiment, where additional higher spatial resolution, but lower temporal resolution and less spatial coverage, thermal as well as velocity data are available. From this, an assessment of present operational products will be made, and future directions in synoptic ocean studies will be defined. The current status of the project (commenced in October 1979), includes the creation of the above mentioned data bases for FRONTS and completion of some preliminary analyses. Ocean Prediction Workshop 1981 was convened in April at NPS under partial sponsorship of this project. There were about 80 civilian and naval attendees. The proceedings are in preparation. Status and requirements were reviewed, and new ideas were brought forward.

Publication:	C. N. K. Mooers, "Surface Atmospheric and Oceanic Variables," pp. 45 to 50, In: FRONTS 80: Preliminary Results From an Investigation of the Wintertime North Pacific Subtropical Front (Ed. C.A. Paulson and P.P. Niiler), School of Oceanography, Oregon State University, Reference 81-2 (January 1981), 108 numbers v. leaves.
Conference Presentation:	C. N. K. Mooers, "Amospheric Forcing and GOES IR Imagery During FRONTS," AGU Fall Annual Meeting, San Francisco, 8 to 12 December 1980. (Abstract in EOS, 61: 981).
Thesis Directed:	L. Monsaingeon, "Ocean Thermal Analysis and Related Naval Operational Considerations in the Ionian Sea--June 1980," Master's Thesis, September 1981.

Title: Horizontal Variability Effects on Optical Propagation in the Upper Ocean

Investigator: J. L. Mueller, Adjunct Professor of Oceanography

Sponsor: Office of Naval Research and Ocean Science and Technology Detachment

Objective: This proposal is part of the "Environmental Effects on Optical Propagation" project, funded by the Office of Naval Research (Code 486) under the Selected Research Opportunity (SRO) program, which is targeted at performance evaluation of the proposed Strategic Laser Communications (SLC) system. This particular proposal is for work to assess the effects which horizontal variability of ocean properties will have on optical propagation predictions based on 1-dimensional models of the upper ocean.

Summary: As part of the Office of Naval Research sponsored Selected Research Opportunity project entitled "Environmental Effects on Optical Propagation," it is proposed to investigate the effects of horizontal variability of the downward vector irradiance coefficient K_T on the accuracy and interpretation of 1-dimensional model predictions of that parameter. A major goal of the parent research project is the development and testing of a 1-dimensional model of the upper ocean in support of the Navy's performance evaluation of the proposed Strategic Laser Communications (SLC) systems. The work proposed here will contribute to the testing of 1-dimensional K_T predictability. The approach will be to first characterize the spectrum of horizontal K_T variance in the open ocean regime through analysis of Nimbus-7 Coastal Zone Color Scanner (CZCS) data. Then, on the basis of that information, the sensitivities of K_T variations to horizontal transports and sub-grid scale fluctuations will be analyzed.

Title: Kinematics of Breaking Waves in the Surf Zone

Investigator: Edward B. Thornton, Professor, Department of Oceanography

Sponsor: Office of Naval Research, Geography Branch

Objective: Basic studies are being made on the kinematics of breaking waves within the surf zone in the field. The specific objectives of the proposed research are: (1) determine breaking criterion as a function of depth, beach slope and wave frequency and (2) determine the transformation of waves across the surf zone due to energy conversion and dissipation in the breaking process.

Summary: Research this past year emphasized the continued analysis of the results of the major field experiments at Torrey Pines, California and Santa Barbara, California, and the development of predictive models. A model describing the transformation of random wave heights was developed based on energy flux balance. Dissipation is considered due to wave breaking and bed friction. Wave breaking is characterized after periodic bores. The random nature of the wave heights is described starting with the Rayleigh distribution in deep water. The Rayleigh distribution is modified by wave breaking with an empirical transfer function. The modified distribution is itself the Rayleigh distribution. The model is compared both with laboratory results and an extensive set of field measurements collected at Torrey Pines Beach, California. The model is able to predict the increase in averaged wave height due to shoaling and subsequent decrease due to wave breaking. The model has only one adjustable parameter ($\gamma = 0.68$) and is able to predict rms wave heights to within a standard error of 9.3% throughout the region from offshore to the beach.

The Rayleigh distribution gives surprisingly good estimates of wave height statistics, even H_{max}, for the spilling breakers measured at Torrey Pines Beach. The percent mean errors over the measured ranges compared with the Rayleigh statistics of $H_{1/3}$, $H_{1/10}$ and H_{max} were -0.2, -1.8 and -6.8%, respectively. The results show the Rayleigh distribution to slightly overpredict the number of

waves in the tail of the distribution, but it is nevertheless able to predict the central statistics of $H_{1/3}$ and even $H_{1/10}$ quite well.

Publications:

R. T. Guza and E. B. Thornton, "Wave Set-up on a Natural Beach," Journal of Geophysical Research, 86, 4133-4137, 1981.

D. A. Huntley, R. T. Guza and E. B. Thornton, "Field Observations of Surf Beat: Part 1, Progressive Edge Waves," Journal of Geophysical Research, 86, 1981.

E. B. Thornton and R. T. Guza, "Longshore Currents and Bed Shear Stress," Proceedings of the Euromech 114 Conference on Waves and Changes in the Surf Zone, Polish Academy of Sciences, 1980.

R. T. Guza and E. B. Thornton, "Swash Oscillations on a Natural Beach" (Accepted J. of Geophysical Research).

E. B. Thornton and R. T. Guza, "Phase Speeds and Energy Saturation Measured on a Natural Beach," submitted to the Journal of Geophysical Research.

E. B. Thornton and R. T. Guza, "Transformation of Wave Height Distribution," submitted to the Journal of Geophysical Research.

Thesis:

Teran, Gallo Padillo, "Transformation of Waves Across the Surf Zone," Master's Thesis, March 1981.

Title: Satellite and Synoptic Studies of Chemical Fronts in the California Current and Coastal Upwelling Zone

Investigator: E. D. Traganza, Associate Professor of Oceanography

Sponsor: Office of Naval Research

Objective: To develop a satellite referenced bio-chemical model of oceanic fronts: to optimize the interpretation of satellite images with respect to thermal, chemical and bio-optical information.

Summary: During the current year we have seen the successful completion of important objectives including (1) the conversion of digitized satellite infrared images to sea surface nutrient maps, (2) the comparison (and remarkable agreement) between in situ distribution of chlorophyll-biomass "blooms" in association with thermonutrient fronts and the distribution of chlorophyll-biomass "blooms" inferred from the Nimbus-7 Coastal Zone Color Scanner (CZCS), (3) investigation of the capability of analyzing plankton production over large frontal regions by using ratios of guanosine triphosphate (GTP) to adenosine triphosphate (ATP) for determining microplankton growth rates, and (4) the completion and successful performance of the towed oceanwater sampling system (TOSS).

Over the past three years there have been thirteen publications (four of which are full papers) and eight masters theses. Three talks (two invited) have been given to international audiences, viz., at the 1980 I.D.O.E. International Symposium on Coastal Upwelling, the 1981 Gordon Research Conference on Chemical Oceanography (invited) and the 1981 NATO Advanced Research Conference on Coastal Upwelling: Its Sedimentary Record (invited). This project has attracted the attention of numerous scientists. Some have initiated studies off Pt. Sur, including dynamic studies by Dr. C. N. K. Mooers and L. C. Breaker (a Ph.D. student) of NPS and satellite ocean color studies by Dr. J. Mueller of NPS, and acoustic studies by Dr. P. Scully-Powers and D. Browning of NUSC. Dr. Neil Andersen of NSF has used this work as an example of the future potential role of satellites in chemical oceanography. Dr. R. Stevenson and Mr. Ben Cagle of ONR have extrapolated our findings to an area of strategic Naval importance.

Publications:

E. D. Traganza, D. A. Nestor and A. K. McDonald, "Satellite Observations of a Nutrient Upwelling off the Coast of California," Journal of Geophysical Research, 85, 4101-4106, 1980.

E. D. Traganza, J. C. Conrad and L. C. Breaker, "Satellite Observations of a 'Cyclonic Upwelling System' and 'Giant Plume' in the California Current," In: Coastal Upwelling, American Geophysical Union, Washington, D.C., 1981.

E. D. Traganza, "Nutrient Distribution and Recurrence of Coastal Upwelling Centers by Satellite Remote Sensing: Its Implication to Primary Production and the Sediment Record," NATO Advanced Research Conference on Coastal Upwelling: Its Sediment Record. Plenum Press, 1982, (forthcoming).

E. D. Traganza, D. A. Nestor and A. K. McDonald, "Satellite Observations of a Nutrient Upwelling Off the Coast of California," EOS Transactions, American Geophysical Union, 61 (14), GAP Abstract 4710, 1980.

E. D. Traganza, W. E. Hanson, S. H. Bronskink and D. M. Austin, "Satellite Inferences, GTP-Microplankton Productivity and Chemodynamic Effects of Upwelling Systems Off Pt. Sur, California," Abstract in: EOS Transactions, American Geophysical Union, 61 (46): 1013, 1980.

Conference Presentations:

E. D. Traganza, "Satellite and Synoptic Studies of the Pt. Sur 'Cyclonic Upwelling System,'" Abstract in Proceedings of: 27th Annual Eastern Pacific Oceanic Conference, UCLA Conference Center, Lake Arrowhead, California, October 8-10, 1980.

E. D. Traganza, "The Use of Satellite Infrared Imagery in Investigating Nutrient Fronts in the Ocean," Invited talk: Gordon Research Conference on Chemical Oceanography at Plymouth State College, Plymouth, N.H., Announced in: Science, Vol. 211, No. 4487, August 3-7, 1981.

E. D. Traganza, "Nutrient Distribution and Recurrence of Upwelling Centers by Satellite Remote Sensing," Invited talk, abstract in Proceedings: NATO Advanced Research Conference on Coastal Upwelling: Its Sediment Record, Villamoura, Portugal, September 1-5, 1981.

Theses Directed:

R. W. Phoebus, "Biological Patchiness in Relation to Satellite Thermal Imagery and Associated Chemical Mesoscale Features," Master's Thesis, June 1981.

C. D. Jori, "Estimating the Distribution and Production of Microplankton in a Coastal Upwelling Front, from the Cellular Content of Guanosine-5' -Triphosphate and Adenosine-5' -Triphosphate," Master's Thesis, September 1981.

V. M. Silva, "Thermal Calibration of Satellite Infrared Images and Correlation with Sea-Surface Nutrient Distribution," Master's Thesis, (forthcoming).

Title: Countercurrents and Eddies in the California Current System

Investigator: A. J. Willmott, Assistant Professor, Department of Oceanography

Sponsor: Office of Naval Research

Objective: To develop theoretical models for the interaction of eddies with mesoscale coastal and bottom topographic irregularities in eastern boundary current regimes. The long term objective of this research is to understand how continental shelf and shelf break circulation is coupled with mid-ocean dynamics. This research effort is part of a continuing program.

Summary: A study of the steady state circulation of a constant barotropic current around an idealized Gaussian headland, located on a flat bottom, mid-latitude β-plane was completed. Coastal orientation and headland geometry were shown to be critical parameters in determining the flow field. The study has shown that eddies observed in the vicinity of the major California headlands may be produced by a flow separation mechanism. A study has also been initiated on the generation of topographic Rossby waves in an oceanic trench. It was shown that surface wind stress directed alongshore can generate a large topographic Rossby wave response along the Aleutian trench. For the Japan-Kuril trench system, the fluctuations within the Kuroshio current, where it flows across the trench, were shown to be capable of generating a significant northward propagating topographic Rossby wave response.

Publications: L. A. Mysak and A. J. Willmott, "Forced Trench Waves," Journal of Physical Oceanography. (forthcoming).

A. J. Willmott, "The Influence of a Coastal Headland on Oceanic Boundary Currents," Geophysical and Astrophysical Fluid Dynamics. (forthcoming).

Conference Presentation: A. J. Willmott, "Forced Trench Waves," Third Conference on Atmospheric and Oceanic Waves and Stability, San Diego, January 19-23, 1981.

Title:	Morphology of Modularity
Investigator:	J. F. Sladky, Jr., Adjunct Professor, of Mechanical Engineering
Sponsor:	Office of Naval Research
Objective:	To develop an insight into the concept of modularization and to attempt to formulate a model that will assist in determining the desirability, effectiveness, and cost of modularization.
Summary:	The study has focused on the examination of modularization efforts in diverse technologies. The project is following a "case study" route and, as such, involves extensive literature and data base developments. The emphasis to date has been on the electronics and transportation industries.